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TECHNICAL MEMORANDUM NO. 74-07

IMPROVED FIRE STARTER FOR ALL-ENVIRONMENT  
SURVIVAL KIT

by

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)  This task was initiated in an effort to develop a fire starting device which could be used in all environments. Commercially available items and the present standard Army butane lighter all have shortcomings which can render them unserviceable. These particular shortcomings could prove fatal to someone who may find himself in a survival situation. Although numerous approaches were investigated and various prototype fire starters were		

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developed and tested, only one item withstood the in-house testing and did not deteriorate under storage conditions. This item was a commercial wooden safety match manufactured in Australia and distributed by Coghlan's Limited, Winnipeg, Canada.

## INTRODUCTION

In 1972, the US Army Land Warfare Laboratory (USALWL) developed an All-Environment Survival Kit under Task 03-S-72 which contained a number of fire starting devices including the standard Army butane lighter, a "misch" metal match, waxed paper and a package of cotton balls. This array of fire starting devices was required to assure a fire starting capability in all environments. It also provided the individual with several methods of fire starting in the event one device became inoperable in extreme environmental conditions. Butane lighters, for example, became unserviceable in extreme cold temperatures and the present Army lighter can expend all fuel if the gate is not properly closed. The "misch" metal is effected by moisture and will deteriorate if improperly stored for an extended period of time. For these reasons, this task was initiated to design and develop one fire starting device for use in all environments.

This report describes an investigation of various fire starting devices to correct these deficiencies and the ultimate selection of a commercial waterproof match as the best candidate for inclusion in the Survival Kit.



## DESCRIPTION

### Design Criteria

To improve the fire starting devices in the All-Environment Survival Kit, desirable characteristics were first established and used as guidelines in planning the scope of work. The fire starter must provide a means of igniting and initially sustaining a fire under survival conditions and should have the following characteristics:

1. Be suitable for use in all climatic and weather conditions in Climatic Categories I through VI.
2. Be capable of functioning in high winds.
3. Be capable of starting a minimum of 30 fires with indigenous tinder or (integral) initial fuel with reasonable wind shielding under survival conditions.
4. Be of a size and weight suitable for inclusion in the All-Environmental Survival Kit (not exceed two ounces in weight or three inches in length).
5. Be moisture proof and nondegradable during normal shelf life.
6. Be nonvolatile except when properly activated.
7. Be nontoxic, contain no element or compound that might infect wounds, and produce flame or fumes which are nontoxic even when in direct contact with food.
8. Not pose a flash-burn hazard during normal ignition.
9. Be reliable and enhance troop acceptability by ease of use.

### Conceptual Planning

Using the above characteristics as guidelines, a fire starter concept was formulated that would include the misch metal match as the basic component. By enclosing the metal match in a resealable container, it would be protected from atmospheric moisture, thereby preventing degradation. In place of a knife (normally used to produce sparks), a hacksaw type striker/shaver was expected to produce an improved sparking capability. The resealable container could also be used to store enough waterproof tinder material to start 30 fires.

### Development of Fire Starter

The contractor, under Contract No. DAAD05-72-C-0209, Work Order No. 10, performed a major portion of the work, and furnished USALWL a number of prototype fire starters. The resealable container was 7/8-inch in

diameter by 3 inches long and was fabricated from Delrin, an acetal resin manufactured by E. I. Dupont de Nemours and Co. The cap was threaded and gave the desired seal. A Delrin holder for the metal match was machined to fit inside the container and served to center the metal match in the container. The resealable container and metal match assembly are shown in Figure 1. A small section of hacksaw blade was secured in a slot in the end of the container, also shown in Figure 1. The telescoping sliding aluminum section as shown, was used to hold tinder. Various tinder materials were placed in the resealable container around the metal match.

The procedure for using the fire starter is shown in Figure 2. Tinder is placed in the aluminum receptacle and the metal match is drawn quickly over the hacksaw scratcher, showering the tinder with hot sparks causing the tinder to ignite. Once ignited, the tinder is transferred to previously prepared kindling.

This fire starting system worked, however, there were a number of problems. Considerable practice is required to gain operational proficiency, and the container must be held on a solid object when drawing the match across the striker, otherwise the tinder was jarred out of the receptacle. The user must quickly transfer the ignited tinder to the kindling, which in turn must be carefully prepared. And finally, the Delrin container would occasionally catch fire, damaging the slotted area containing the striker. Despite its shortcomings, the fire starting device in the hands of a trained person was capable of starting the required thirty fires.

The investigation of waterproof tinder materials was quite comprehensive. Various synthetic fibers and thinner sheer materials were tested and most were rejected as being only marginally successful. The most successful materials were cellulose nitrate sheet and solid propellants. Not all grades of cellulose nitrate ignite readily, however, and after testing a number of different types, Parlodion strip (pyroxylin) manufactured by the Mallinkrodt Chemical Works was determined to be the best grade. This is a hospital grade used for mounting membranes and is sold in sheets 0.040-inch thick. For use as a tinder, the material was cut into 1/4-inch squares, and approximately one-half dozen squares placed in the fire starter receptacle. When ignited with hot sparks from the metal match, the cellulose nitrate would burn vigorously for approximately ten seconds.

Solid propellant in sheet form was found to ignite easier than the cellulose nitrate. In addition the propellant, known as HEN-12, burned longer than the cellulose nitrate. Matches, using Delrin sticks with the propellant bonded on the end were fabricated and tested. This provided a tinder material which is easily ignited and burns for a considerable period of time. Investigations were conducted to find a propellant which could be dip coated on the end of the Delrin sticks. Both the Naval Ordnance Station, Indian Head, MD and Thiokol Chemical Corporation, Elkton, MD agreed to supply sample materials for this purpose. When the propellant material was received from the Naval Ordnance Station, Delrin sticks were coated and tested, but the flaming misch metal particles would not ignite the propellant. When lit by other means, the pyrotechnic would not ignite the Delrin. Uncured propellant was received from Thiokol and was hand molded on the ends



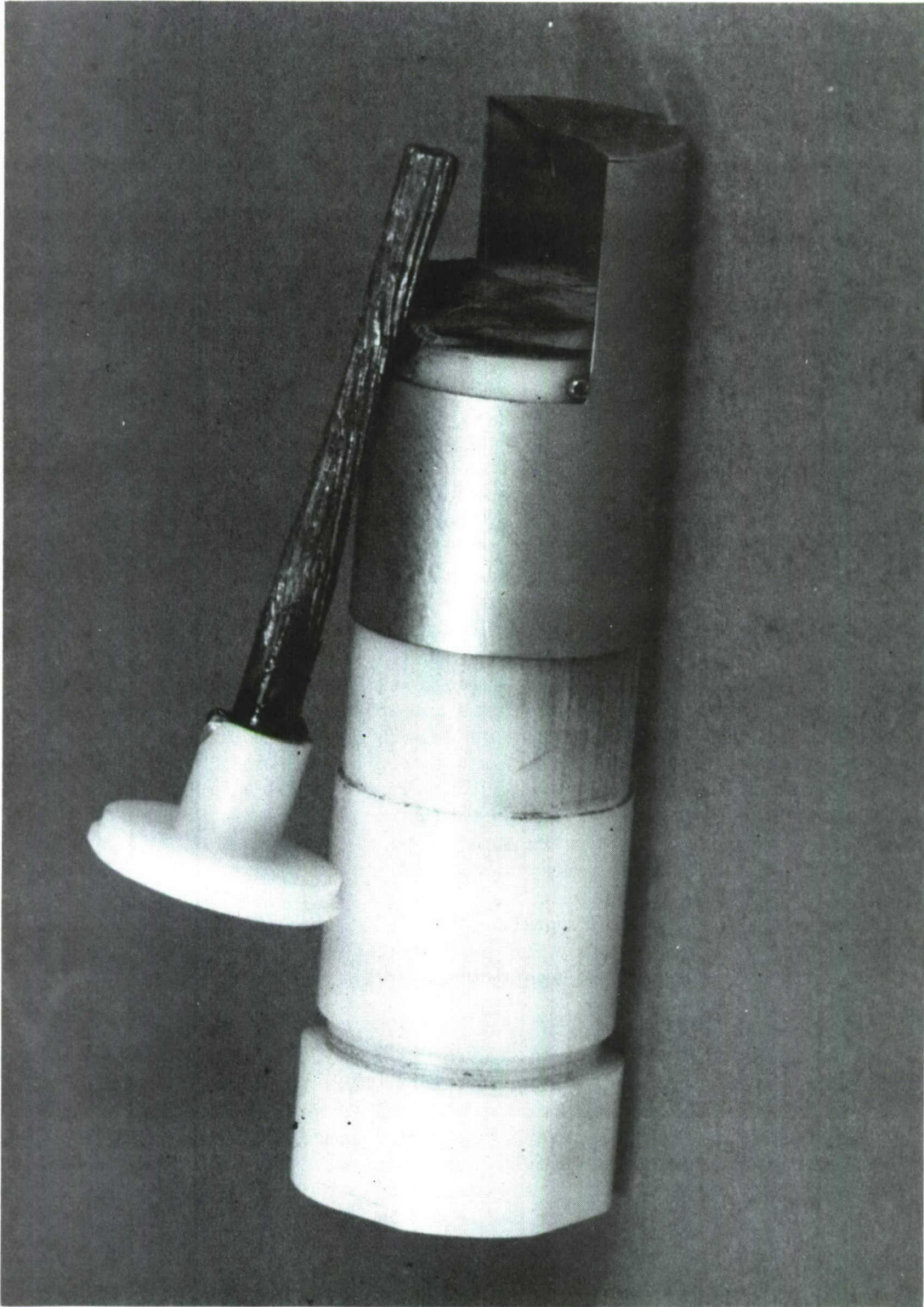


Figure 1. Fire Starter Assembly



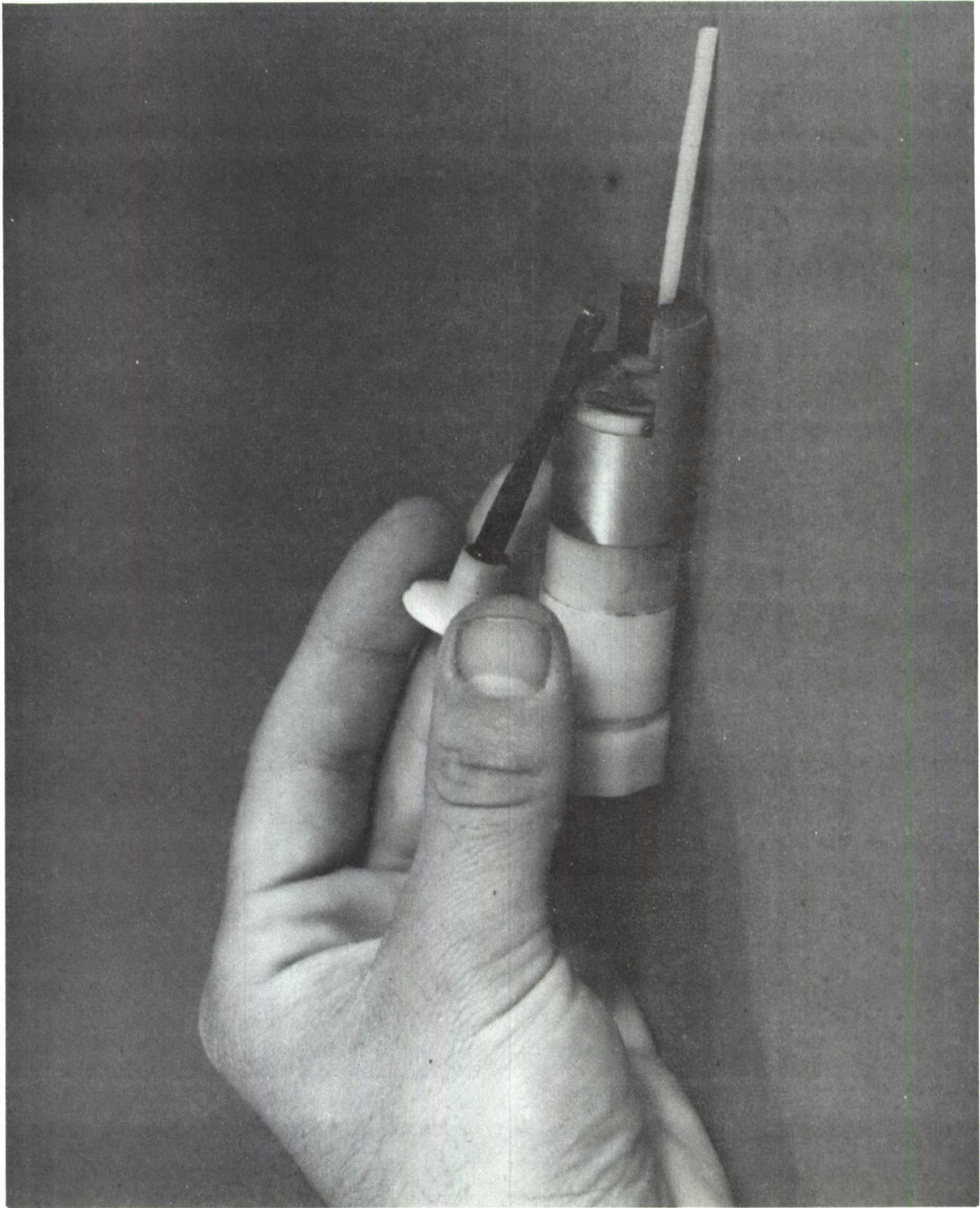


Figure 2. Operation of Fire Starter

of Delrin sticks. The assemblies were then cured and tests were conducted with the fire starter. The results were unsatisfactory. The propellant was difficult to ignite and the ignition of the Delrin stick was not reliable. The propellant also burned somewhat violently, presenting some hazard to the user.

During the course of the investigation of tinder materials, a commercial waterproof wooden safety match was purchased and tested. The matches are manufactured in Australia and distributed by Coghlan's Limited, Winnipeg, Canada under the trade name Coghlan's Waterproof Wooden Safety Matches. They are packaged, fifty matches per box, with waterproof strikers on the sides of the match box.

The Coghlan matches were tested by placing them in a 100 percent relative humidity chamber for a period of three weeks. At the conclusion of this test, all matches functioned satisfactorily. Some of the matches were also placed in water for several days without any recognizable deterioration.

## RESULTS

In a survival situation an individual is often exposed to extreme cold weather, snow, or cold, rainy conditions. A fire could mean the difference between life or death. The quickest method of building a fire is by the use of a match with which he is familiar. The waterproof Coghlan match is ideal for this purpose.

The metal match-tinder combination requires some training, takes time to prepare and requires finger dexterity. An individual with cold or freezing fingers may not have the required dexterity and it would be impossible to use when wearing Arctic mittens. For these reasons, the original fire starter concept was dropped in favor of the waterproof matches.

## CONCLUSIONS

1. The Coghlan waterproof match is superior to the USALWL metal match concept which was investigated.
2. Based on limited in-house testing, it appears that the waterproof match will provide the necessary all-environment fire starting capability.

## RECOMMENDATION

The Coghlan matches should be included in the All-Environment Survival Kit.



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